

# AERONAUTICAL AND ASTRONAUTICAL ENGINEER

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## **PROPAGATION OF A TWO-PHASE DETONATION ACROSS A GEOMETRIC DIFFRACTION WITH COMPOSITIONAL DISCONTINUITY**

**Todd A. Hofstedt-Lieutenant, United States Navy**

**B.S., United States Naval Academy, 1993**

**Aeronautical and Astronautical Engineer-June 2000**

**Advisors: Christopher M. Brophy, Department of Aeronautics and Astronautics**

**David W. Netzer, Department of Aeronautics and Astronautics**

**Raymond P. Shreeve, Department of Aeronautics and Astronautics**

The research program involved the modification and use of an existing pulse detonation engine (PDE) to investigate the detonability of a JP-10/air aerosol. The detonation of a JP-10 aerosol in air proved more difficult than was originally anticipated.

The use of a small JP-10/oxygen pre-detonator to provide direct initiation results in a transition region with a geometric diffraction and compositional discontinuity. Propagation of a detonation into such a region is very complex but critical to the re-establishment of the detonation wave in the JP-10/air mixture. A high-speed camera was used to image the wave in the transition region and provide spatial information. High frequency pressure transducers were used along the combustor axis to determine wave speed. The ultimate goal was to determine the conditions required to ensure reliable re-establishment of a detonation wave in the JP-10/air aerosol mixture.

Unfortunately, the confined planar JP-10/oxygen detonations in the pre-detonator were unable to transition into unconfined spherical detonation fronts in the JP-10/air aerosol. Furthermore, the ratio of main combustor diameter to pre-detonator diameter was too large to allow re-initiation of detonation at the main combustor wall.

**DoD KEY TECHNOLOGY AREA:** Aerospace Propulsion and Power

**KEYWORDS:** JP-10, Detonations, Pulse Detonation Engines, Tactical Missile Propulsion

# MECHANICAL ENGINEER

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## AN EXPERIMENTAL APPROACH FOR STUDYING CREEP BEHAVIOR OF MODEL PLANAR INTERFACES

**Keith A. Peterson-Lieutenant, United States Navy**

**B.S., Florida Institute of Technology, June 1990**

**Mechanical Engineer-June 2000**

**Master of Science in Mechanical Engineering-June 2000**

**Advisor: Indranath Dutta, Department of Mechanical Engineering**

An apparatus for measuring the steady state creep behavior of interfaces in aluminum-silicon-aluminum multilayered specimens has been assembled. In the experiment scheme, a double-shear specimen geometry was used to load the interfaces in a state of nominally constant shear. The deformation kinetics for interfacial sliding during constant shear stress creep experiments were measured for various applied interfacial shear stress levels and temperatures. Interfacial shear strain rates were measured using displacement and capacitance gauges. The planar interfaces between the aluminum and silicon layers were prepared by diffusion bonding. Preliminary results indicate that that interfacial sliding occurs via time-dependent relaxation mechanisms and that there is a threshold stress for interfacial sliding, in agreement with previous work on lead-Quartz and lead-nickel interfaces. The preliminary values obtained for the activation energy for interfacial sliding in this aluminum-silicon-aluminum multilayered system is low ( $\sim 30\text{KJ/mol}$ ), and is believed to be due to interfacial diffusion of aluminum atoms. In general, the activation energy is thought to be dependent on the structure and chemistry of the interface.

**DoD KEY TECHNOLOGY AREAS:** Materials, Processes, and Structures, Electronics

**KEYWORDS:** Interface Sliding, Diffusion Bonding, and Creep